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OPERATING EXPERIENCE SUMMARY

Office of Nuclear and Facility Safety

November 4 – 17, 1999

Summary 99-46

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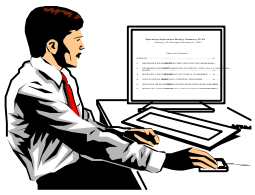

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EVENTS

1. TECHNICIAN RECEIVES UPTAKE DURING GLOVEBOX GLOVE CHANGEOUT

On November 1, 1999, at Los Alamos National Laboratory, a Radiological Control Technician (RCT) observing glovebox operations to change out a defective glove received an uptake of plutonium-239. A second RCT and a nuclear materials technician were replacing the glove, which had a hole in the armpit, while the first RCT and two other employees observed the operation. During the glove change-out, a radioactive release triggered a continuous air monitor, and all personnel immediately evacuated the area. Nasal smears indicated that the observing RCT received a low-level uptake. Results for the other personnel involved were negative; however, health physics personnel placed all five workers on bioassays. The facility manager closed off the work area. Health Physics personnel surveyed the surrounding area and found no evidence that the contamination had spread. Airborne contamination can transcend work zone boundaries leading to unexpected uptakes. (ORPS Report No. ALO-LA-LANL-TA55-1999-0041)

Investigators learned that, prior to the operation, Health Physics personnel established a hot job exclusion area and erected a plastic post and rope barrier with radiological zone signs 10 feet from the location of the glove-change operation. The RCT observing the operation stood 5 feet beyond the barrier, along with two other employees. Only the RCT and the nuclear materials technician who were performing the change-out wore respirators. Site procedures require that only workers within the hot job exclusion area must wear respirators. Following the event it was determined that other continuous air monitors in the vicinity of the hot job area displayed elevated readings. The five people involved in the event received nasal smears. Analysis of the continuous air monitor filter indicated a maximum level of airborne radioactivity of 228 dpm alpha contamination per cubic meter.

EH notes that a similar event occurred on November 9, 1999, at the Rocky Flats Environmental Technology Site, where a glovebox glove seal failed, releasing particles and contaminating a worker. (ORPS Report RFO-KHLL-ANALYTOPS-1999-0014). EH also reported a glovebox work control issue in OE Summary 99-30 where, on July 13, 1999, at the Hanford Plutonium Finishing Plant, a technician's personal protective equipment became contaminated when a glove was sucked into a glovebox during reactivation of a glove port. Technicians were returning the glove port to service following a period of extended deactivation. They were required to use two procedures, one for removing the port cover and another for changing the glovebox glove. Technicians successfully removed the port cover. The supervisor then removed the tape holding the old glove in place before an inner ring was installed to hold the new glove in place. This was not in accordance with the procedure and caused the glove to be sucked into the glovebox during the glove change. Weaknesses in glove port activation work control resulted in the uncontrolled spread of contamination and could have resulted in personnel intake of radioactive material. (ORPS Report RL--PHMC-PFP-1999-0029)

KEYWORDS: glovebox, contamination, procedures

FUNCTIONAL AREAS: Procedures, Hazards Analysis, Work Control

2. DOE ORDERS STAND-DOWN AT OAK RIDGE Y12 FACILITY

On November 6,1999, at the Oak Ridge Y12 facility, DOE and Lockheed Martin Energy Systems (LMES) initiated an operational stand-down for enriched uranium operations. The stand-down resulted from concerns related to a recent readiness assessment review. During the assessment, DOE reviewers identified a lack of management attention to conduct of operations, that surveillance on furnace safety interlocks was not performed in compliance with approved procedures, and that insufficient procedural training resulted in unauthorized equipment being prepared to perform a specific task. Reviewers also determined that adherence to criticality safety requirements for the movement of nuclear material was inadequate. LMES ordered the suspension of fissile material activities until operations and support staff complete safety awareness immersion training. The readiness assessment review was conducted using non-nuclear material, and there was no danger to employees or the public. (ORPS Report ORO--LMES-Y12NUCLEAR-1999-0062)

The stand-down resulted in the following actions:

- Suspension of fissile material activities effective November 5, 1999.
- Initiation of safety awareness immersion training for operations and support personnel. This training will be completed before operations are resumed.
- Increased oversite of enrichment operations by LMES line management.
- Implementation of LMES' independent oversite group upon resumption of re-start operations.
- Changes in personnel in the enrichment operations management structure.
- Initiation of causal analysis and corrective action planning.

EH has reported other work stand-downs and suspensions in the OE Summary.

OE Summary 99-06 reported that the Los Alamos Neutron Science Center division director and the facility manager determined that a voluntary shutdown of operations at the facility would be necessary to address potential safety concerns. The shutdown was prompted by the fact that, in the first month of calendar year 1999, the facility had five reportable occurrences compared to an average of just 17 to 18 occurrences per year. (ORPS Report ALO-LA-LANL-ACCCOMPLEX-1999-0006)

OE Summary 98-33 reported that the division director for the Los Alamos Pajarito Laboratory ordered a stand-down of site operations following a critique of an event in which nuclear material storage mass limits were exceeded. Based on a discussion of procedures and formality of operations, he concluded that there had been a pervasive lack of formality in site operations. (ORPS Report ALO-LA-LANL-TA18-1998-0008)

OE Summary 96-47 reported that a facility manager at the Savannah River Central Services Works Engineering facility issued a stand-down order to a subcontractor following two events involving safety procedure violations. The order prohibited the subcontractor from performing any work on site until its personnel had been retrained on the site safety manual. Facility Evaluation Board members reported electrical safety concerns that involved an incorrect lockout/tagout and failure to use personal protective equipment near energized equipment. (ORPS Report SR--WSRC-CSWE-1996-0010)

These events underscore the importance of managers exercising their authority to suspend operations in the interest of facility and personnel safety. Being proactive and voluntarily suspending work is the proper course of action when an undesirable safety trend is identified. Managers of DOE facilities should review the following guidance to assist them in determining readiness.

DOE O 440.1a, *Worker Protection Management for DOE Federal and Contractor Employees*, encourages the involvement of employees in developing program goals, objectives, and performance measures, and in identifying and controlling hazards in the workplace. Procedures should be implemented that allow workers, through their supervisors, to stop work when they discover imminent danger or serious hazards.

DOE-STD-1120-98, *Integration of Environment, Safety, and Health into Facility Disposition Activities*, provides guidance for enhancing worker, public, and environmental safety. It supports integrated safety management system principles to guide the safe accomplishment of work activities. These principles include (1) line management responsibility for safety, (2) clear roles and responsibilities, (3) competence commensurate with responsibilities, (4) balanced priorities, (5) identification of safety standards and requirements, (6) hazard controls tailored to work being performed, and (7) operations authorization.

DOE O 5480.19, *Conduct of Operations Requirements for DOE Facilities*, contains guidance for the conduct of operations based on well-developed industrial operations practices. These guidelines form a compendium of good practices and their implementation should result in a high level of performance. Included in this document is guidance for management observation and monitoring of operations, and for use of procedures.

DOE Orders can be found at http://www.explorer.doe.gov. Integrated safety management information can be found at http://tis-nt.eh.doe.gov/ism. DOE technical standards are at http://tis.eh.doe.gov/techstds/.

KEYWORDS: management, operations, shutdown, stop work

FUNCTIONAL AREAS: Lessons Learned, Management, Operations

3. AIR-FED HOOD SUPPLY CONNECTION FAILS

On November 2, 1999, at the Hanford site, an electrician who was making repairs to an inert blower inside an airborne radiation area, lost his air supply when the tubing to his LANCS air-fed hood disconnected from the hood fitting. The electrician lifted the lower part of the hood to allow easier breathing and a radiological control technician escorted him out of the area. The radiological technician surveyed the electrician and found no evidence of contamination. Failure of an air supply can result in workers breathing contaminated air or losing consciousness. (ORPS Report RL--PHMC-FFTF-1999-0010)

The investigators determined that the electrical worker wore the air hood (LANCS model L1520Y) both for comfort and to prevent facial contamination while repairing an inert gas blower located in a contamination area. They also determined that the tube connection, at the hood, had no crimping collar to bind the tygon air supply tubing to the hood fitting. Safety personnel inspected similar hoods and found the supply tubing to be properly crimped. Investigators determined that the manufacturer performs the crimping before shipping the hoods. Site personnel contacted the manufacturer, LANCS, and reported the failure. Safety personnel checked similar hoods and found no additional problems with
crimping. Figure 3-1 shows the type assembly used for the model L1520Y air hood.

Figure 3- 1. LANCS Model L1520Y Assembly

EH personnel reported other respiratory equipment problems in the Operating Experience Summary.

OE Summary 96-48 reported that safety personnel at Brookhaven National Laboratory discovered that a quick-operating connection on a facemask for a self-contained breathing apparatus failed during confined space training. The failure occurred inside the air mask at the air supply connection. (ORPS Report CH-BH-BNL-BNL-1996-0016)

OE Summary 95-36 reported that maintenance personnel at Rocky Flats discovered deficiencies on four air line hoses while performing final checks of supplied-air respiratory equipment before entering a plutonium component storage area. One hose completely separated from the crimped fitting; the other three failed leak-test criteria. (ORPS Report RFO--KHLL-PUFAB-1995-0018)

OE Summary 94-30 reported that the Nuclear Regulatory Commission issued an Information Notice on problems with inadvertent separation of the mask-mounted regulator from the face piece on the Mine Safety Appliances Company self-contained breathing apparatus. (NRC Information Notice 94-35)

Hanford training personnel revised respiratory use procedures to indicate that workers who wear respirators or air-supplied equipment should check their issued equipment for operability or defects before usage.

These events underscore the importance of carefully checking respirator condition and fit before entering areas where protection is required. They also illustrate the importance of a thorough check of equipment before use to identify any defects. DOE/EH-0256T, *Radiological Control Manual*, part 3, "Respiratory Protection Program," discusses equipment and requirements of respiratory protection programs, and the manual also provides additional references.

KEYWORDS: respirator

FUNCTIONAL AREAS: Industrial Safety, Radiation Protection

4. ELECTRICAL DISCHARGE MACHINE OPERATOR SUFFERS MILD SHOCK

On October 26, 1999, at Oak Ridge National Laboratory, a machine operator received a shock to his left hand while aligning a brass electrode on an Electrical Discharge Machine (EDM). The EDM is an electrical arc-heating machine with a capacitor that has 7 to 15-volt, 8 to 10-ampere input and output terminals that feed the brass electrode. The design of the EDM power control switch did not include a mechanical guard or stop mechanism. As the machine operator manipulated the power switch with his right hand, he inadvertently moved the switch past "stand down" to "on" and received a shock that numbed his left hand. Laboratory personnel took the worker to the ORNL Medical Center, where he was treated, released with no restrictions, and scheduled for a follow-up examination in 2 days. Ergonomics and design of machinery controls can affect personnel safety. (ORPS Report ORO--ORNL-X10PLEQUIP-1999-0011)

Investigators determined that an electrical output test on the EDM indicated a peak of 153 volts at the electrode within a few seconds. This voltage is high enough to cause serious personnel injury. They also determined that because the control switch had no mechanical guard, handling of the electrode and the power control switch simultaneously increases the potential for a shock. Laboratory personnel installed a mechanical guard on the control switch to ensure that operators must use both hands to manipulate it. They also revised operating procedures to require that operators position the electrode prior to energizing it.

EH has reported a number of similar events in the OE Summary where ergonomics or design of machinery has led to injury.

OE Summary 99-38 reported that, on September 1, 1999, at Rocky Flats, a process specialist sustained lacerations to several fingers when his anti-contamination glove and cotton liner became entangled in a rotating pump shaft during a waste transfer operation. He immediately turned off the pump, exited the area, and requested assistance. Fire department personnel responded and transported the process specialist to the site medical department. Site medical personnel decontaminated his wounds and transported him to an off-site medical facility where his lacerations were treated. Rotating equipment hazards can result in severe injuries or fatalities. (ORPS Report RFO--KHLL-NONPUOPS2-1999-0003).

OE Summary 98-13 reported that on March 27, 1998, at Ames Laboratory, a supervisor of electrical services was severely injured when part of his clothing apparently became entangled with a rotating shaft on a supply fan. The supervisor and another worker were inspecting a duct smoke detector located inside a supply fan room of an air-handling unit. They turned the supply fan off at a control panel outside the supply fan room, then entered the room before the fan came to a complete stop. The supervisor carried a short ladder into the room and moved around the shaft-end of the fan housing so he could access the smoke detector. Investigators believe that part of his clothing came in contact with the still rotating shaft and became entangled. The supervisor was airlifted to a regional hospital where doctors performed life-saving surgery and subsequent surgery to save his arms. A Type B Accident Investigation Board identified a failure to assess hazards to be a major cause for this event. (ORPS Report CH--AMES-AMES-1998-0002)

These events underscore the importance of proper ergonomic considerations in machine design to ensure physical safety of operating personnel. Appropriate safety features, such as mechanical guarding of rotating parts and separation of working steps in operating procedures, provide additional safety barriers that prevent accidents.

OSHA publication 3067, *Machine Safeguarding*, 1992, states: "any machine part, function, or process which may cause injury must be safeguarded." It also states that when the operation of a machine or accidental contact can injure personnel in the vicinity, the hazards must be either controlled or eliminated. This publication describes various hazards of mechanical motion and presents some techniques for protecting workers. It is available at http://www.osha-slc.gov/Publications/Mach_SafeGuard/.

KEY WORDS: mechanical guarding, ergonomic deficiency

FUNCTIONAL AREA: Industrial Safety, Electrical Safety

5. WORKER SUSTAINS SEVERE HEAD INJURY OPENING JAMMED DUMPSTER DOORS

On November 1, 1999, at the Monticello Mill Site, a subcontractor worker attempted to pry open the jammed doors of a dumpster with an iron bar. When the doors suddenly opened, the bar slipped, and the door struck the worker, causing severe head injuries. Emergency response personnel transported the worker to a local hospital. He was later airlifted to a Hospital in Grand Junction, Colorado, where he is in stable condition. The worker was not wearing a hard hat and safety glasses. A Type B investigation is in progress. EH engineers will follow the investigation and will provide additional information, when it becomes available. (ORPS Report ALO--MCTC-GJPOTAR-1999-0004)

KEYWORDS: personnel protection

FUNCTIONAL AREAS: Industrial Safety

6. ACID SOLUTION SPLASHES ON WORKER'S FOOT

On November 1, 1999, at the Savannah River Site, a maintenance mechanic was removing an outlet line from a pump used for transferring 40% ferrous sulfamate liquid. While removing the line, a solution of process water, containing a small amount of ferrous sulfamate, splashed onto the cloth bootie covering the mechanic's ankle. The mechanic sensed a tingling sensation on his ankle and was immediately placed under a safety shower. After this flush, he was taken to a medical facility where the ankle was again washed. Health physics personnel checked for radioactive contamination and none was found. (ORPS Report SR—WSRC-HCAN-1999-0052)
The pump in question had been transferring process water used in equipment checkouts, so it was considered clean at the time. To facilitate removal of the outlet line, the mechanic placed his foot atop the pump housing next to the outlet line to obtain leverage and began manipulating it. When the outlet line dislodged from the pump, a small amount of this solution splashed onto the cloth bootie of his foot located atop the housing. The investigators believe a small amount of ferrous sulfamate was trapped between the outlet line and pump-housing discharge pipe it was attached to and was released when that connection was broken.

The mechanic wore an acid suit while performing this job, but the suit had no integral hood or boots. The suit has elastic cuffs around the ankles, wrists, and neck, and is used primarily where acid releases may occur above a worker's waist. The elastic ankle cuffs of the suit are designed to rest atop the plastic shoe covers, thereby protecting the ankle area when the worker is standing in an upright position. When the mechanic placed his foot atop the pump, the suit's pant-leg "crept up" his leg, exposing the bootie covering his ankle. An acid suit with integral boots could have prevented this event. Investigators determined that these suits were available for use although they were not stocked in the facility at the time. Neither the mechanic nor the industrial hygienist involved in this event was aware of the availability of these suits. Site work planners and industrial hygienists have indicated they will now specify use of suits with an integral hood and boots for operations involving acid solutions.

This event illustrates the importance of identifying hazards and providing the worker with the appropriate personnel protective equipment. This event could have had more serious consequences had the concentration of the acid been higher. Facility managers responsible for planning work on systems containing hazardous chemicals or with flow paths connected to

hazardous chemicals should be conservative when establishing work zone boundaries and choosing personnel protective equipment.

Information on chemicals, chemical hazards, and chemical safety programs can be found on the DOE Office of Environment, Safety and Health, Office of Worker Safety, Chemical Safety Program website at http://tis.eh.doe.gov/web/chem_safety/. This site provides links to many sources of information, including requirements and guidelines, lessons learned, chemical safety networking, and chemical safety tools.

The following DOE and industry documents provide additional guidance for all personnel who work with chemicals and hazardous materials.

- DOE-HDBK-1100-96, *Chemical Process Hazards Analysis*, February 1996, and DOE-HDBK-1101-96, *Process Safety Management for Highly Hazardous Chemicals*, February 1996, provide guidance for DOE contractors managing facilities and processes covered by the Occupational Safety and Health Administration (OSHA) Rule for Process Safety Management of Highly Hazardous Chemicals (29 CFR 910.119).Both handbooks are available at http://tis.eh.doe.gov/techstds/.

- DOE Defense Programs Safety Information Letter, SIL 96-01, “Incidents from Chemical Reactions Due to Lack of or Failure to Follow Proper Handling Procedures,” June 1996, provides guidance to prevent these incidents.

KEYWORDS: chemical reaction, pressurized, injury, labeling, acid

FUNCTIONAL AREAS: Materials Handling/Storage, Procedures, Research and Development

7. BURN TESTS SHOW THAT FLOOR MATS CONTRIBUTE TO COMBUSTIBLE LOADING

On November 1, 1999, at the Pantex Plant, fire protection engineers identified safety concerns while testing rubber floor mats for ignition and combustibility. Pantex Weapons Program procedures require the combustible loading to be minimized, justified, and approved by fire protection engineers. Honeycomb rubber floor mats are used at the facility to reduce the risk of a high explosive drop in areas where high explosives safety is a factor. Various ignition tests demonstrated that the rubber mats ignited during credible fires making them a significant source of fuel. Fire protection engineers recommended removing the mats and replacing them with a noncombustible material or covering them with a noncombustible material. Materials used in high explosives areas can contribute to combustible loading, increasing the risk of loss from fire. (ORPS Report ALO-AO-MHSM-PANTEX-1999-0074)

Investigators determined that the honeycomb floor mats were excluded from the cell fire source term without adequate justification. Fire protection engineers performed a series of tests that demonstrated that the mats contributed to combustible loading. They used a 9-square-foot section of mat as a base on which to ignite paper wipes, isopropyl alcohol, butyl gloves, and nitrile TNT gloves. The mat ignited and continued to burn during the tests involving the alcohol and butyl gloves. Investigators determined that the airflow characteristics associated with the raised feet on the mats also contributed to flame propagation. Based on test results, fire protection engineers drafted an engineering evaluation identifying immediate compensatory measures that included prohibiting the storage of combustible materials on the mats and a process to heighten employee awareness about mat safety concerns.

Decisions to use rubber floor mats should be made with care because mats can contribute to a facility's combustible loading. As a minimum precaution, combustible materials should not be stored on or near rubber mats.

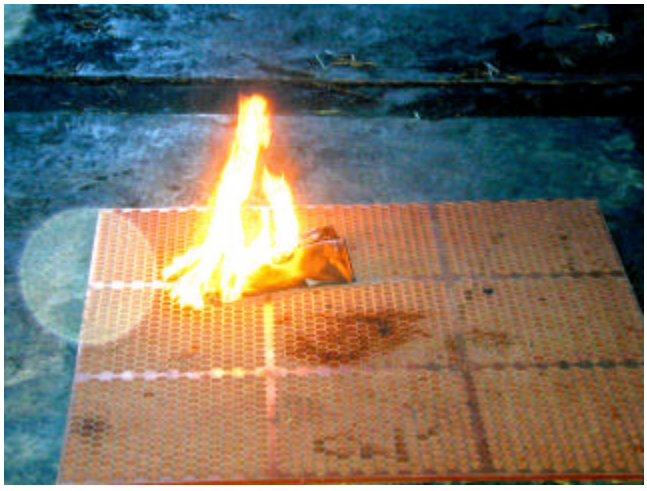

Figure 7-1. Burning Glove Igniting Rubber Floor Mat

KEYWORDS: fire, rubber, combustible, ignition, combustible loading

FUNCTIONAL AREAS: Fire Protection

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